AMENDMENTS TO THE SPECIFICATION

Please add the following new paragraph before page 1, line 1:

This application claims priority to Japanese Patent Application 11-308750 filed on October 29, 1999.

Please replace the paragraph beginning on page 2, line 16 with the following amended paragraph:

Operation of transmitting and receiving systems of the conventional communication device using the turbo code will be explained in detail below. Fig. 8 is a drawing that shows the construction of a turbo encoder used in the transmitting system. In Fig. 8(a), reference numeral 101 denotes a first recursive system convolutional encoder that subjects an information list to a convolutional encoding process to output redundant bits. Reference numeral 102 denotes an interleaver, and reference numeral 103 denotes a second recursive system convolutional encoder that subjects the information list that has been switched by the interleaver 102 to a convolutional encoding process to output redundant bits. Fig. 8(b) is a drawing that shows the inner structures of the first recursive system convolutional encoder 101 and the second recursive system convolutional encoder 103, and the two recursive system convolutional encoders are encoders that only output redundant bits respectively. Moreover, the interleaver 102, which is used in the turbo encoder, randomly switches information

bit lists.

Please replace the paragraph beginning on page 16, line 18 with the following amended paragraph:

Moreover, in the encoder in Fig. 1(a), reference numeral 1 denotes a turbo encoder that uses turbo codes as error-correction codes so as to provide a performance close to the Shannon limit and 2 is a conversion for converting data received from the turbo encoder 1. In the turbo encoder ~~21~~, for example, with respect to an input of two-bit information bits, two-bit information bits and two-bit redundant bits are outputted, and in the conversion 2, with respect to the received 4-bit data, calculations are carried out so as to uniform the correction capabilities with respect to the information bits on the receiving side.

Please replace the paragraph beginning on page 5, line 14 with the following amended paragraph:

Since no preliminary information has been given at the time of the first decoding process, $La(U_k) = 0$, for an initial time value (k) = 0.

Please add the following new paragraph before the paragraph beginning on page 7, line 23:

The following aspect of the communication device is disclosed with reference to Figure 1.

Please replace the paragraph beginning on page 5, line 16 with the following amended paragraph:

In the interleavers 113 and 114, in order to make the received signal: y1k and the external information: $Le(U_k)$ coincident with the time of the received signal: y_3, the signals are re-arranged. Then, in the same manner as the first encoder 111, based upon the received signal: y_1 and the received signal: y_3 as well as the external information: $Le(U_k)$ preliminarily calculated, the second decoder 115 calculates a logarithm likelihood ratio: $L(U_k)$. Thereafter, in the same manner as the adder 112, the adder 116 calculates the external information $Le(U_k)$ by using equation (2). At this time, the external information, rearranged by the ~~interleave~~ deinterleaver 117, is fed back to the first decoder 111 as the preliminary information: $La(U_k)$.

Please replace the paragraph beginning on page 15, line 1 with the following amended paragraph:

Fig. 1 is a drawing that shows constructions of an encoder and a decoder that are used in a communication device in accordance with the present invention; Fig. 2 is a drawing that shows a construction of a transmitting system of a transmitter in accordance with the present invention; Fig. 3 is a drawing that shows a construction of a receiving system in accordance with the present invention; Fig. 4 is a drawing that shows a tone

construction in a multi-carrier modem system and a construction of an encoder that is applicable to a 4-bit constellation; Fig. 5 is a drawing that shows a layout of signal points in various digital modulations; Fig. 6 is a drawing that shows a circuit construction of a turbo encoder 1; Fig. 7 is a drawing that shows a difference in bit error rates; Fig. 8 is a drawing that shows a construction of a conventional turbo encoder; and Fig. 9 is a drawing that shows a construction of a conventional turbo ~~encoder~~ decoder.

Please replace the paragraph beginning on page 17, line 21 with the following amended paragraph:

Prior to explaining the operations of the encoder and decoder, an explanation will be briefly given of the basic operation of the communication device in the present invention by reference to Figures 1-7. For example, with respect to the cable-type digital communication system for carrying out data communication by using the DMT (Discrete Multi Tone) modem system, there are xDSL communication system including an ADSL (Asymmetric Digital Subscriber Line) communication system that executes a high-speed digital communication with several megabits/second by using the existing telephone lines and an HDSL (high-bit-rate Digital Subscriber Line) communication system. Here, these systems are standardized in T1.413 of the ANSI, etc. In the explanation of the present embodiment, for example, a communication device that is

applicable to the ADSL is used.

Please replace the paragraph beginning on page 19, line 3 with the following amended paragraph:

Thereafter, the transmission data is subjected to a rate converting process in rate ~~converters~~ convertors (corresponding to RATE-CONVERTORS) 47, 48, and then subjected to a tone ordering process in the tone ordering (corresponding to TONE ORDE~~R~~RING) 49. Based upon the transmission data after the tone ordering process, constellation data is formed in a constellation encoder/gain scaling (corresponding to CONSTELLATION AND GAIN SCALING) 50, and this is subjected to an inverse Fast Fourier transform in an inverse Fast Fourier transform section (corresponding to IFFT: Inverse Fast Fourier transform) 51.

Please replace the paragraph beginning on page 24, line 5 with the following amended paragraph:

The following description will discuss the operation of the turbo encoder 1 shown in Fig. 4(b) that carries out the turbo encoding process on the inputted lower two bits of the received data: u_1 and u_2. Fig. 6 is a drawing that shows the circuit construction of the turbo encoder 1. Reference numeral 21 denotes a first recursive system convolutional encoder. Reference numerals 22 and 23 denote interleavers. Reference numeral 24 denotes a

second recursive system convolutional encoder, and reference numeral 25 denotes a deinterleaver. In the turbo encoder 1, the transmission data: u_{1k} and u_{2k} (with k representing the time) corresponding to the information list

Please replace the paragraph beginning on page 24, line 24 with the following amended paragraph:

In this manner, in the present embodiment, the arrangement in which the die-interleaver 25 is added to the second recursive convolutional encoder 24 as its following stage is used so that the times of the transmission data and the redundant data are made coincident with each other; thus, it is possible to efficiently carry out the calculating processes in the succeeding conversion 2.

Please replace the paragraph beginning on page 30, line 17 with the following amended paragraph:

In this manner, in the present embodiment, even when the constellation increases as the modulation system is multi-valued, the turbo decoder for carrying out a soft-judgment on the lower two bits of the received signal that are more susceptible to degradation in the characteristics and the judging device for carrying out a hard-judgment on the other bits of the received signal are provided; thus, it is possible to reduce the soft-judgment portions having a great amount of calculations, and also

to achieve a good transmitting characteristic in the same manner as the conventional device. Additionally, in the transmission path having random errors and burst errors in a mixed manner as described in the present embodiment, by adopting the R-S codes (Reed Solomon) 3, 4 for carrying out error corrections on a symbol basis and other known error-correction codes in a combined manner, it is possible to obtain a further superior transmission characteristic.

Please replace the paragraph beginning on page 34, line 10 with the following amended paragraph:

In accordance with the next invention, the communication ~~made~~ device is made applicable to communication using the multi-carrier modem system, and is provided with a turbo encoding unit and a computing unit. Therefore, even when the constellation increases as the modulation system is multi-valued, it is possible to reduce the amount of calculations, and also to achieve a good transmitting characteristic in the same manner as the convolutional method. Moreover, a soft-judgment is carried out on the lower two bits of the received signal that are more susceptible to degradation in the characteristics, and a hard-judgment is carried out on the other bits of the received signal. Therefore, even when the constellation increases as the modulation system is multi-valued, it is possible to provide a communication method which can reduce

the soft-judgment portions having a great amount of calculations, and also achieve a good transmitting characteristic in the same manner as the conventional method.

Please replace the paragraph beginning on page 35, line 9 with the following amended paragraph:

In accordance with the next invention, even in a transmission path having random errors and burst errors in a mixed manner, since the R-S codes for carrying out error corrections on a symbol basis are combinedly used, it becomes possible to provide a communication method which achieves a further superior transmission characteristic.